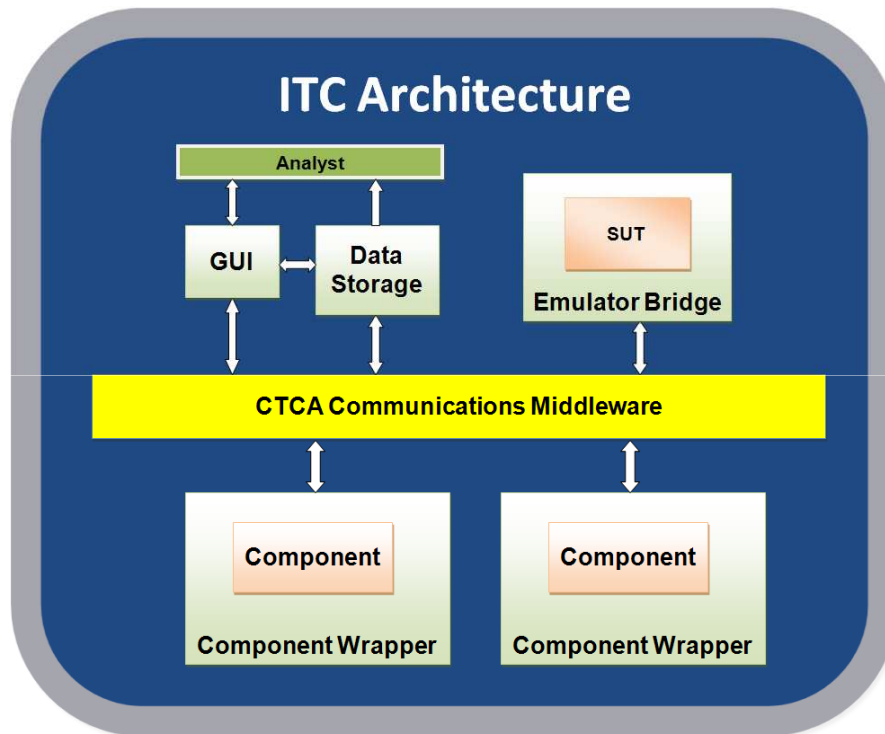


Abstract

- The ITC Processes and Procedures presentation describes how the ITC team plans to infuse the new dynamic analysis capability into the current IV&V workflow. This presentation outlines the test approach for independent testing and how to scope the effort using IV&V's current risk based methodology. It also outlines the roles, responsibilities, and deliverables of the three primary stakeholders involved in independent testing (NASA Project, IV&V Project, and the ITC Team).



IV&V Workshop Independent Test Capabilities (ITC) Processes and Procedures

September 16, 2010

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Agenda

- Recommended Approach
- Roles and Responsibilities
- GPM Example
- Future Project Support
- Summary

IV&V's Test Approach

- IV&V's dynamic analysis will focus on **functionally testing** the software delivered by the NASA projects.
 - Functional testing is defined in the NASA Software Safety Guidebook 8719.13 as a **black-box type testing geared to functional requirements** of an application.
 - Black-box testing is defined as testing that is **not based on any knowledge of internal design or code**. The tests are based on requirements and functionality.
- IV&V's functional testing will be a **complement** to the existing testing performed by the NASA project.
 - The IV&V project will utilize the ITC framework in an attempt to **satisfy the "Three Questions" against preselected behaviors/capabilities using independent tests** developed by the IV&V analysts.
 - IV&V's functional testing will be of **limited scope** based on risk assessments of the mission's requirements and/or behaviors/capabilities.

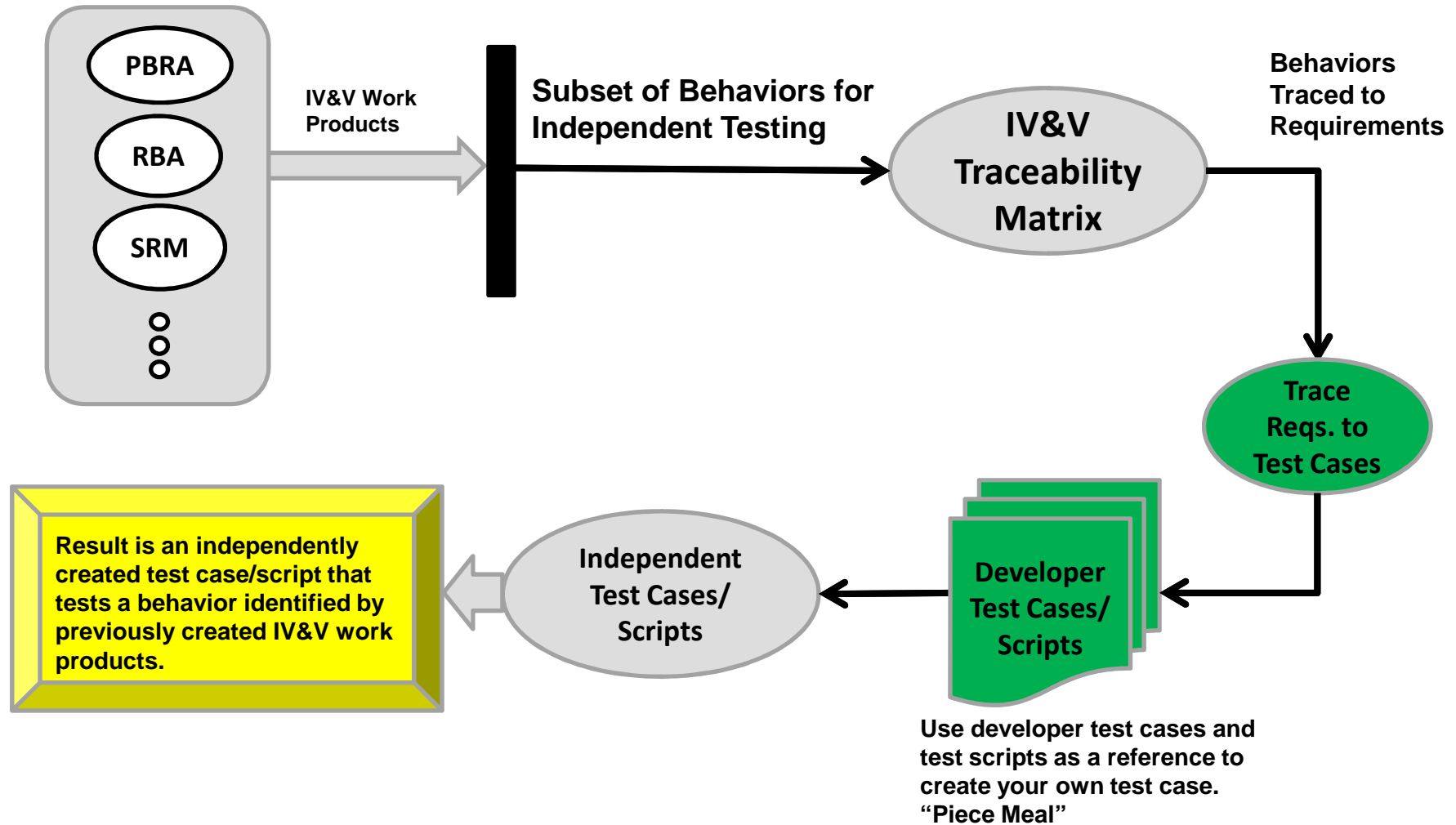
Scope of IV&V Testing

- Determining the scope of testing is a shared responsibility between IV&V project and the ITC team
 - IV&V project should lead this effort as they are the system experts
 - Identify areas of test (based on previous IV&V work products)
 - Develop test scenarios/cases, test procedures, and test scripts
 - ITC Team will continually provide the IV&V project with simulation capabilities and provide training on simulation tools and technologies
 - Disclaimer
 - IV&V **will not duplicate all of the Verification and Validation (V&V) of the NASA project's requirements** that have been tested prior to IV&V receiving the software. The scope of the IV&V's testing will be established via IV&V's risk assessments of the project.
 - IV&V tests **will not be all inclusive of the software's functionality**. Software capabilities that are demonstrated during the NASA project's V&V testing are not necessarily demonstrated during IV&V's testing. **IV&V selects certain behaviors/capabilities to test** and will not duplicate all of the testing performed by the NASA project.
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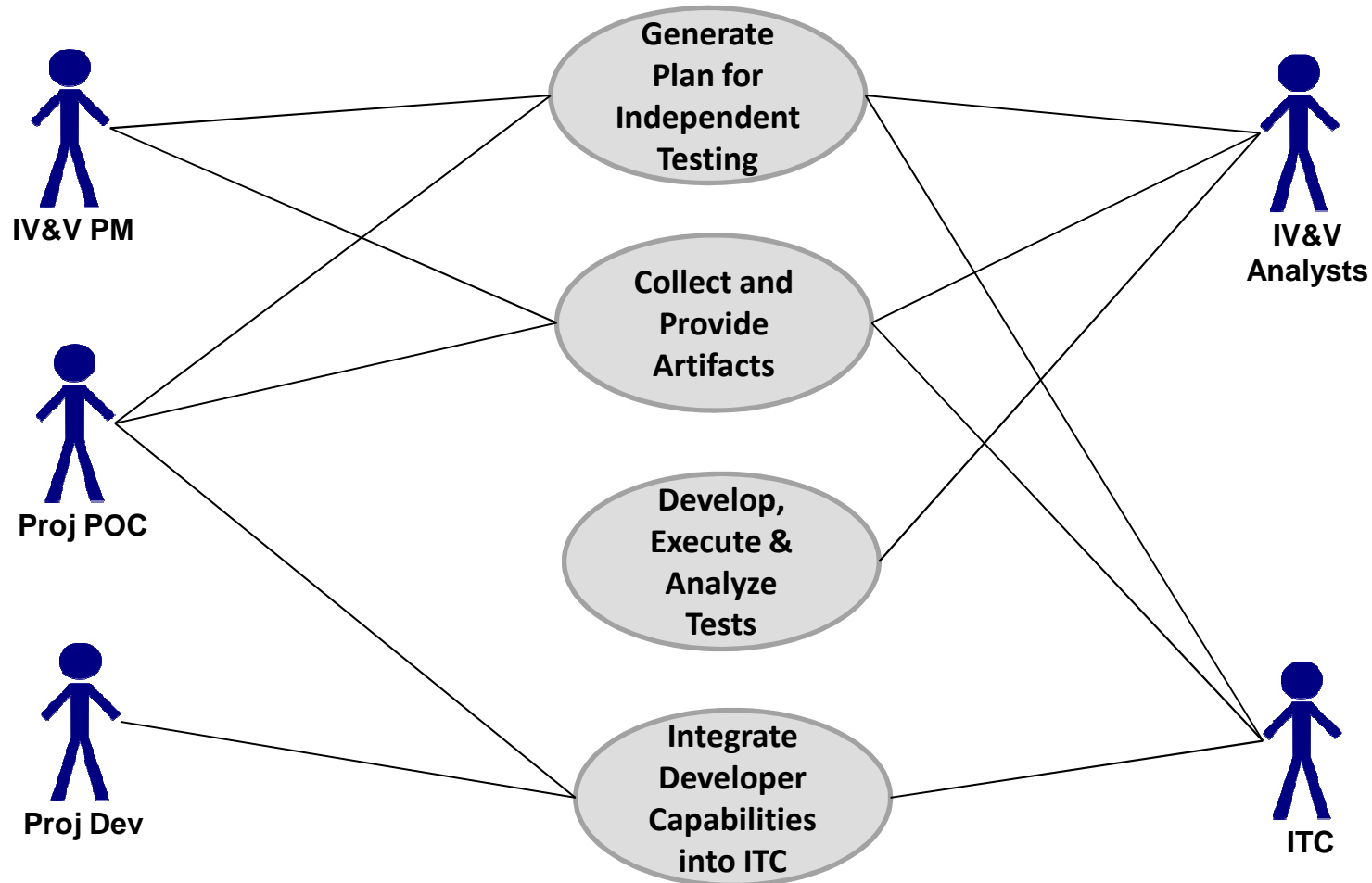
Example Test Areas

- Areas where IV&V may perform testing
 - Verify in scope functional requirements (based on risk assessments)
 - Execute de-scoped tests that are desirable
 - Test software interfaces
 - Execute regression tests
 - Fault Injections
 - Off-Nominal Tests
 - Scenarios identified by IV&V analysts during requirements analysis work
 - Execute stress tests

One Method for Generating Independent Tests



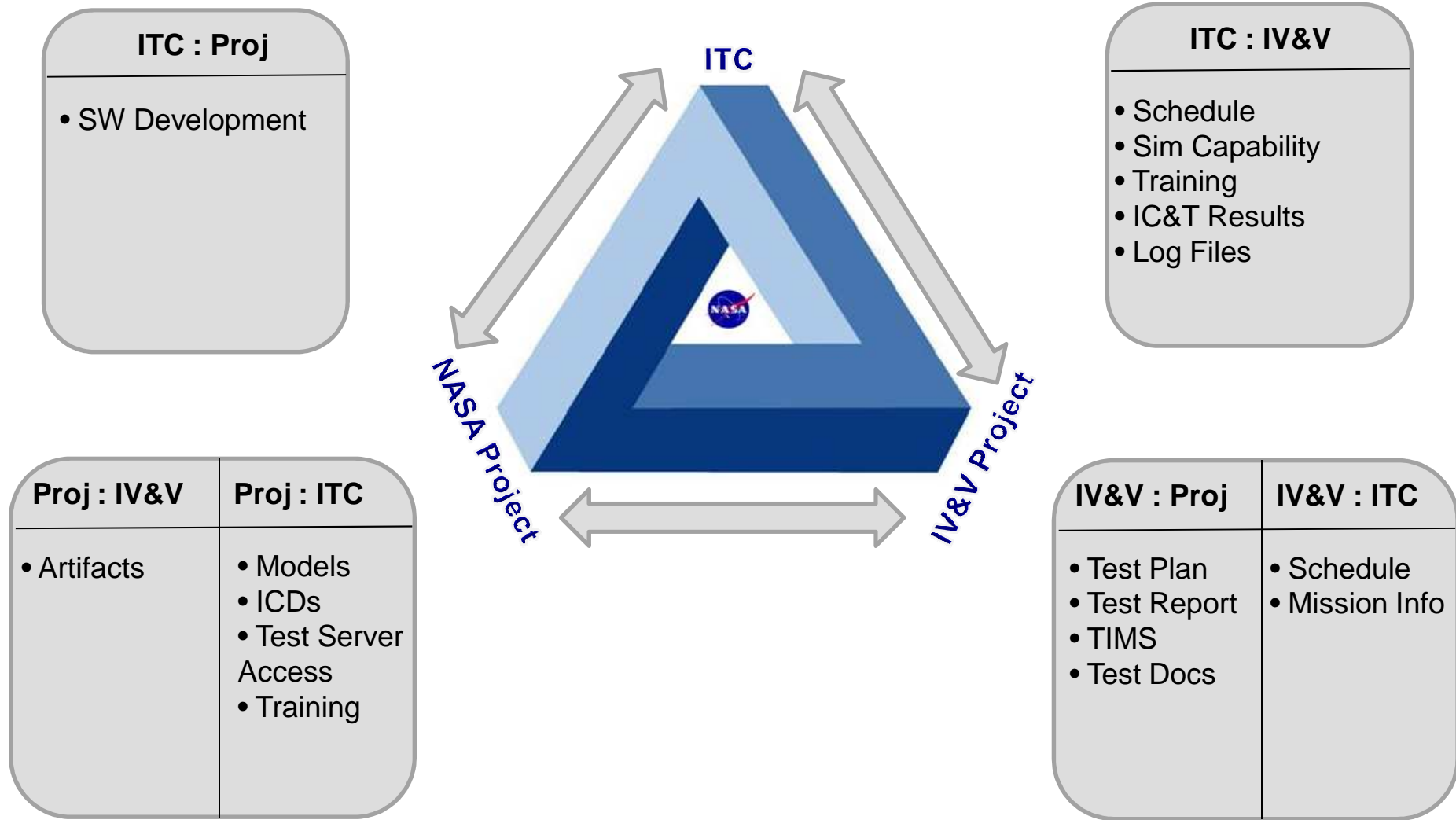
Roles and Responsibilities





Independent Test Capability

Communication Triangle



- **IV&V Project to NASA Project**
 - **Test Plan**
 - The IV&V project, with assistance from the ITC team, will create a separate test plan for each NASA project. The test plan will identify the scope of the dynamic testing effort, the approach, resource and environmental needs, schedule, objectives, and the behaviors to be verified and validated through functional testing.
 - **Test Report**
 - At the conclusion of the testing, the NASA IV&V project will compile a test report to summarize the results from testing the selected behaviors/capabilities as well as any issues and/or observations documented.

- **IV&V Project**

- **IV&V Project Schedule**

- The IV&V project should provide the IV&V project schedule to the ITC Lead in order to properly coordinate and plan the ITC testing effort.

- **Test Scenarios**

- The IV&V analysts will use the NASA mission's concept of operations (CONOPS) in conjunction with the appropriate capabilities and/or requirements documents to develop the test scenarios necessary to verify and validate the selected mission and safety related behaviors. In some cases lower-level requirements documents may be used if deemed necessary to achieve the scenario robustness required to satisfy test objectives.

- **Test Procedures**

- The IV&V analysts will create natural language test procedures that provide the test setup and preparation as well as the steps that will be turned into executable procedures (i.e. test scripts).

- **Test Scripts**

- The IV&V analysts will create test scripts using developer artifacts as well as the previously created natural language test procedures.

- **ITC to IV&V Project**
 - **ITC Schedule**
 - The ITC Lead will provide the IV&V project manager with the ITC's schedule. The schedule will include the needed date for the test documentation and test scripts to support Install, Checkout, and Test (IC&T).
 - **Results from IC&T**
 - The ITC engineers will perform IC&T of the software. In preparation for IV&V testing, the ITC engineers will perform the installation of the software in the ITC environment. The ITC engineers will perform a benchmark test using the test scripts from the NASA project. Executing these scripts and using the test execution summaries or documented expected results, the ITC will benchmark and verify the simulation environment.
 - The ITC team will use the IC&T activity to assist in troubleshooting the independent test scripts created by the IV&V project.

GPM IV&V Example

- ITC member integrated with GPM IV&V project
 - Attends various meetings and is on team's distribution list
 - Obtained access to multiple IV&V and GPM project repositories
 - GPM IV&V's ECM and IMAP
 - GPM Management Information System (MIS)
 - GPM MKS (contains requirements, code, and test documentation)
 - ITC team has established the initial simulation environment using GPM FSW and GPM ground system (ASIST)
 - Additional work is in progress to integrate Goddard Dynamic Simulator (GDS) and science instrument simulations for GMI and DPR.
 - ITC provided initial draft of *GPM IV&V Test Plan* to IV&V project
 - GPM IV&V project has included ITC efforts in FY 11 IPEP
 - GPM IV&V is using previous IV&V work products to identify areas for functional testing
 - In the process of generating test scenarios, test procedures, and test scripts
-

Future Project Support

- ITC effort must be properly scoped
 - ITC does not have endless resources
 - Project selection is key during early stages of the ITC
 - Current projects being researched
 - MMS
 - AFSS
 - GRAIL
 - MAVEN
 - SMAP
 - NASA projects must be willing to share information with and provide accesses to the ITC that usually is not provided to the IV&V project
 - Must reiterate to project that **ITC does not perform IV&V**
 - ITC provides IV&V with additional tools to perform their mission of **independent** verification and validation
-

Summary

- IV&V dynamic analysis will focus on functional testing and is scoped by IV&V's risk assessments and previous work products
- ITC will need to be integrated into IV&V project in order to understand the mission and provide insight into the ITC's simulation capabilities
- ITC maintains the simulation environment and assists in troubleshooting during IC&T
- IV&V project is responsible for generating independent tests and executing the tests using the ITC framework

Communication and information sharing between IV&V, ITC, and NASA projects is KEY to successful independent testing.



QUESTIONS?



BACK-UP SLIDES

One Method for Generating Independent Tests

- Prerequisites:
 - Portfolio Based Risk Assessment (or other risk based assessment) has been completed and has scoped the behaviors in which IV&V will be performing their analysis.
 - Traceability matrix linking behaviors to requirements
- Procedures for Generating:
 - Identify a behavior or a sub-set of behaviors the IV&V project would like to test using existing IV&V work products as a reference (PBRA, RBA, SRM, reuse analysis, etc.)
 - Use the IV&V traceability matrix to trace the requirements associated with the previously identified behaviors to developer test cases and test scripts.
 - Use developer test cases and test scripts as a reference to create your own test case that would test the behavior.
 - Use multiple developers' test scripts to construct independent test script(s) that can be used to test the selected behavior(s).

Roles and Responsibilities

User / Stakeholder	User Description and Role
IV&V Project Manager	<p>The PM is a civil service employee that is responsible for the overall leadership and direction of the IV&V efforts. The PM is responsible for establishing the goals and objectives of the IV&V efforts, performing the RBA efforts, performing project management/financial management, project tracking and oversight and risk management of the IV&V efforts. <i>The PM is to ensure that the ITC efforts are included in the IV&V Project Execution Plan (IPEP) and communicated to the Project POC.</i></p> <p>The Project Manager is also responsible for <i>identifying appropriate project points of contact for the ITC team and working with the ITC to determine the appropriate artifacts and resources needed.</i> The PM will need to have appropriate funding for the necessary testing tools and resources and will need to work with the ITC team to identify an appropriate schedule for the work to be done.</p>

Roles and Responsibilities

User / Stakeholder	User Description and Role
ITC Team	<p>(Developer) The ITC team is <i>responsible for the development and maintenance of the simulation testing environment (ITC framework)</i>. The ITC team consists of a Lead, Software Developers, Testers, and Quality Assurance personnel.</p> <p>(User) During initial efforts on the GPM project, it is assumed that the ITC team will aid in performing the initial testing activities in order to provide a full end-to-end solution to the IV&V program to support dynamic analysis processes.</p> <p>(IV&V Project POC) <i>One ITC member will attend IV&V project meetings, be added to project distributions, and serve as the single POC between the ITC team and the IV&V project.</i></p>
IV&V Project Analyst	<p>(User) The IV&V project analyst is the primary user of the ITC framework. <i>Project analysts are responsible for developing natural language test scenarios and test procedures as well as test scripts</i>. Project analysts will perform the testing to include regression testing, stress testing, and performance-based testing. Project analysts are responsible for executing the tests, analyzing the test results, and writing issues and observations against their findings.</p> <p>(ITC POC) <i>One IV&V project member will serve as the single POC between the ITC team and the IV&V project.</i></p>

Roles and Responsibilities

User / Stakeholder	User Description and Role
NASA Project Point of Contact (POC)	<p>The NASA project POC serves as the designated Project interface for the IV&V efforts. Responsible for providing artifacts or access to artifacts and associated schedules in support of the IV&V efforts (electronic access is preferred). Responsible for review of IV&V analysis results and ensuring appropriate levels of coordination in terms of resolution of any shortcomings with the system/software as revealed from these analysis results.</p> <p><i>The NASA project POC also helps ensure effective and efficient communications between the development project and ITC team members and timely delivery of all needed artifacts.</i></p>
NASA Project Software Developers and Testers	<p>(Customer) NASA project software developers and testers are the end customers of the issues, observations, and reports produced by the IV&V analysts. <i>The ITC has also found that having access to a software developer and/or tester for a given project increases effectiveness while decreasing time spent on some critical tasks.</i> Communicating with software developers and testers provides valuable insight to ITC team members on the technologies and techniques already being implemented on a given project.</p> <p>(Potential ITC Developer) Although most likely infrequent, NASA project software developers and testers could serve as valuable members of the ITC team if agreements are made early in the project's lifecycle to collaborate on the development of simulation and test environments. <i>For the GPM project, this role is being addressed by members of the GPM Operational Simulator (Go-Sim) development team.</i></p>